Missouri Department of Natural Resources

Biological Assessment Report

Sweetwater Creek
Reynolds County, Missouri

Fall 2011 – Spring 2012

Prepared for:
Missouri Department of Natural Resources
Division of Environmental Quality
Water Protection Program
Water Pollution Control Branch

Prepared by:
Missouri Department of Natural Resources
Division of Environmental Quality
Environmental Services Program
Water Quality Monitoring Section

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1.0 Introduction

Sweetwater Creek [Water Body Identification (**WBID**) number 2764] is located in southeastern Missouri within the Ozark/Black/Current Ecological Drainage Unit (**EDU**; Table 1; Figure 1). Sweetwater Creek is approximately 8 miles long from its headwaters, approximately 5 miles southeast of Bunker, Missouri, to its confluence with Logan Creek. Logan Creek drains into the Black River approximately 3 miles west of Piedmont, Missouri. Sweetwater Creek is located in Reynolds County, Missouri (Table 1; Figure 2).

Much of Sweetwater Creek is a class "**P**" stream, which means it maintains permanent flow even during drought periods (MDNR 2010c). This stream has beneficial use designations for livestock and wildlife watering (**LWW**); protection of warm water aquatic life (**AQL**); and whole body contact (**WBC**), Category B (MDNR 2010c). The WBC "Category B" applies to waters designated for whole body contact recreation not contained within category A. Category A is defined as:

> those water segments that have been established by the property owner as public swimming areas allowing full and free access by the public for swimming purposes and waters with existing whole body contact recreational use(s). Examples of this category include, but are not limited to, public swimming beaches and property where whole-body contact recreational activity is open to and accessible by the public through law or written permission of the landowner (MDNR 2010c).

1.1 Justification

In a study of Ozark streams in the lead-zinc mining areas of the New Lead Belt in southeastern Missouri, Poulton et al. (2009) suggested that Sweetwater Creek and other streams in the Viburnum Trend were affected, if not impaired, by excess heavy metals concentrations. Brumbaugh et al. (2007) found pore water and sediments enriched with lead in Sweetwater Creek. Allert et al. (2008, 2009) found that metals concentrations associated with current mining activities in the Viburnum Trend had negative effects on crayfish populations.

This study was requested by the Missouri Department of Natural Resources (**MDNR**), Water Protection Program (**WPP**), Water Pollution Control Branch (**WPCB**). The 2011-2012 biological assessment study was conducted by the Division of Environmental Quality (**DEQ**), Environmental Services Program (**ESP**), Water Quality Monitoring Section (**WQMS**) and Chemical Analysis Section (**CAS**). This study includes stream habitat assessments, biological assessments, and dissolved metals analysis in surface water.

1.2 Objectives

- Assess the quality of stream habitat.
- Assess the "protection of aquatic life" designated use status using the macroinvertebrate community.
- Assess physicochemical water quality.

- Measure several heavy metals concentrations in the surface water.

1.3 Null Hypotheses

1. Stream habitat quality will be similar between test and control stations.
2. Macroinvertebrate Stream Condition Index (**MSCI**) scores and individual biological metric scores will be similar between stations and to wadeable/perennial reference stream biological criteria.
3. Physicochemical water quality will be similar between stations, and parameters will meet the Water Quality Standards (**WQS**) of Missouri (MDNR 2010c).
4. Dissolved metals concentrations in the surface water will be similar between stations and within acceptable levels when compared to WQSs of Missouri.

2.0 Methods

Kenneth B. Lister, Brian Nodine, and others of the ESP, WQMS staff conducted this study. Methods are outlined in this section. The study timing is outlined. The study area and station descriptions, EDUs, and land uses are identified. Stream habitat assessment procedures are discussed. Biological assessment procedures, which include macroinvertebrate community and physicochemical water sampling analyses, are discussed in this section.

2.1 Study Timing

Sampling was conducted in the fall of 2011 and the spring of 2012. Stream habitat assessments were conducted at both stations on September 28, 2011. Fall 2011 macroinvertebrate and water quality samples were collected at station #1 on September 28, 2011, and collections were made at station #2 on September 29, 2011. Spring 2012 samples were collected at both stations on March 21, 2012.

2.2 Study Area, Station Locations, and Descriptions

The study area and stations are located in the Ozark/Black/Current EDU (Table 1; Figure 1). Two stations were allocated for study in this project (Table 1; Figure 2). Station #2 was positioned immediately upstream of WBID 2764. Its watershed encompasses approximately 3.3 square miles. Station #1 is near the downstream end of WBID 2764, approximately 150 yards upstream from the confluence of Sweetwater and Logan creeks. Station #1 has approximately 9.3 square miles of watershed. A stream habitat assessment (only) was conducted on Blair Creek, Shannon County for use as a control.

2.2.1 Ecological Drainage Unit

Sweetwater Creek is located in the Ozark/Black/Current EDU; Figure 1. EDUs are areas that are delineated and identified by their natural terrestrial physiographic division and major riverine watershed components. EDUs are further described in Sowa et al. (2007). Similar-size streams within an EDU are expected to contain similar habitat conditions and aquatic communities. Comparisons of stream habitat, biological and physicochemical components between test stations and references, or similar-size control streams within the same EDU should then be appropriate.

Table 1
Locations and Descriptions Sweetwater Creek and Control Station

Station	County	Location	Description; WBID	Purpose; Class
Sweetwater Creek #2	Reynolds	SE sec. 28, T. 31 N., R. 02 W. E663104 N4134618 epe 5.1	Upstream of CR759 LWC	Test; U
Sweetwater Creek #1	Reynolds	NW sec. 02, T. 30 N., R. 02 W. E0666026 N4131961 epe 6.7	Upstream of CR760 LWC; WBID 2764	Test; P
Blair Creek #1	Shannon	NW sec. 31, T. 30 N., R. 02 W. E0658499 N4123533 epe 6.6	Upstream of CR 242 LWC	SHAPP Control; P

CR=County Road; LWC = low water crossing; WBID = Water Body Identity Number; U=Unclassified; P=permanent flow.

2.2.2 Land Use Description

Land use was compared among test stations, controls (candidate references), and the Ozark/Black/Current EDU using a 12-digit Hydrological Unit scale (**HUC-12**; Table 2). Percent land cover data were derived from Thematic Mapper satellite data collected between 2000 and 2004 and interpreted by the Missouri Resource Assessment Partnership (**MoRAP**).

Land use or cover should be considered when examining stream habitat assessment or biological assessment results between stations or with the EDU. Land cover was relatively similar between the Sweetwater Creek stations and the Blair Creek [*Stream Habitat Assessment Project Procedure* (**SHAPP)** control] station, as well as with the general land cover of the Ozark/Black/Current EDU. All stations and the EDU are dominated by forest. Grassland was the second most prevalent land use at Sweetwater Creek, the SHAPP control, and in the EDU.

Table 2
Percent Land Use in the Sweetwater Creek, Reynolds County, and the Ozark/Black/Current EDU

Stations	HUC-12 1101000-	Urban	Crops	Grass	Forest	Wetland	Open water
Sweetwater Creek #2	70401	2.9	0.4	9.1	86.4	0.2	1.1
Sweetwater Creek #1	70401	2.9	0.4	9.1	86.4	0.2	1.1
Blair Creek #1 (Control)	80501	0.2	0.0	1.2	98.2	0.0	0.3
Ozark/Black/Current EDU	--	1	0	23	72	1.0	0.0

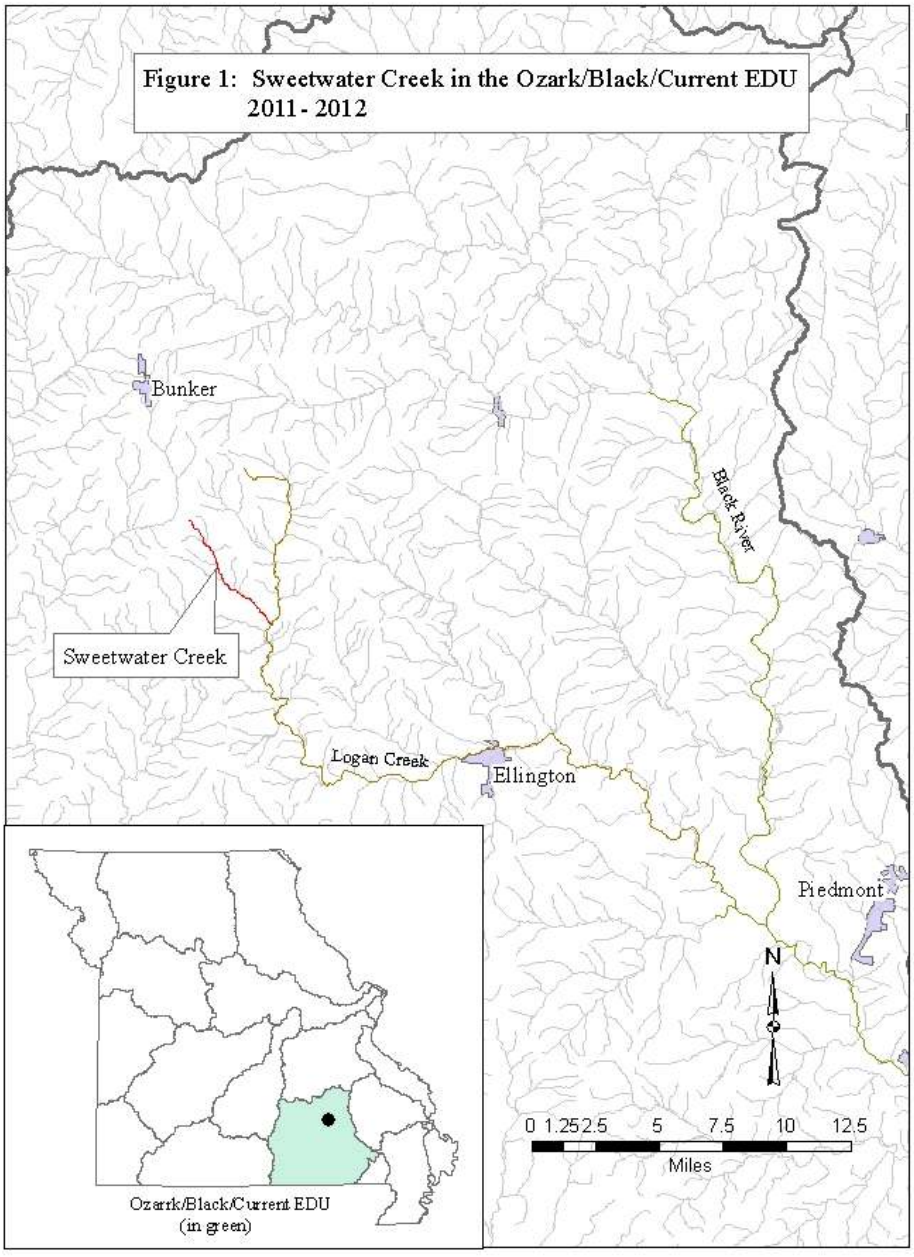


Figure 1: Sweetwater Creek in the Ozark/Black/Current EDU
2011 - 2012
Bunker
Black River
Sweetwater Creek
Logan Creek
Ellington
Piedmont
N
0 1.252.5 5 7.5 10 12.5
Miles
Ozarrk/Black/Current EDU
(in green)

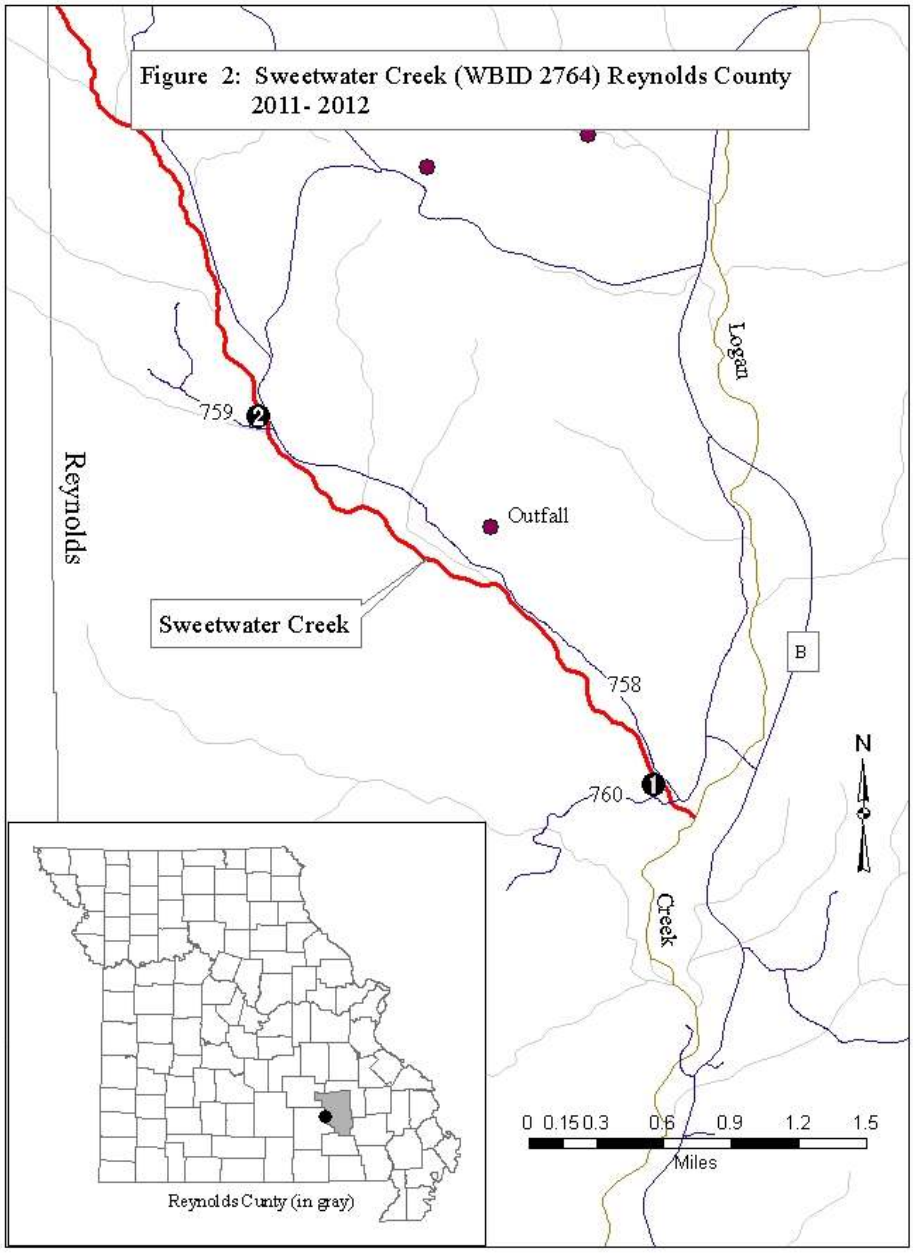


Figure 2: Sweetwater Creek (WBID 2764) Reynolds County
2011- 2012
Reynolds
Logan
759
2
Outfall
Sweetwater Creek
758
B
760
1
N
Creek
0 0.15 0.3 0.6 0.9 1.2 1.5
Miles
Reynolds County (in gray)

2.3 Stream Habitat Assessment Project Procedure

The standardized SHAPP was followed as described for Riffle/Pool prevalent streams (MDNR 2012a). According to the SHAPP, the quality of an aquatic community is based on the ability of the stream to support the aquatic community. If SHAPP scores at test stations are ≥75% of the mean control scores, the stream habitat at the test station is considered to be comparable to the control streams. The SHAPP scores from Sweetwater Creek stations were compared to the score at Blair Creek (SHAPP control) and are expressed as a percentage of the control.

2.4 Biological Assessment

Sampling was conducted as described in the MDNR *Semi-quantitative Macroinvertebrate Stream Bioassessment Project Procedure* (**SMSBPP,** MDNR 2010b). Biological assessments consist of macroinvertebrate community and physicochemical water sampling and analyses. Primary and secondary metrics were examined and are grouped by season and station.

2.4.1 Macroinvertebrate Sampling and Identification

Macroinvertebrate samples were collected from multiple habitats, as described in the SMSBPP (MDNR 2010b). Sweetwater Creek is considered a riffle/pool dominant stream. As such, coarse substrate (**CS**; riffle), non-flowing water over depositional substrate (**NF**), and rootmat (**RM**) habitats were sampled. Macroinvertebrates were subsampled in the WQMS lab according to the SMSBPP (MDNR 2010b) and identified to specific taxonomic levels to allow standardized calculation of the metrics (MDNR 2012b).

2.4.2 MSCI and Primary Biological Metrics

Primarily, analyses conducted on the macroinvertebrate community consisted of examination of MSCI scores and the individual primary biological metrics values that were used to generate the MSCI (MDNR 2010b).

An MSCI is a qualitative rank measurement of a stream's aquatic biological integrity (Rabeni et al. 1997). The MSCI was further refined for reference streams within each EDU in *Biological Criteria for Perennial/Wadeable Streams* (MDNR 2002). This refinement allows for comparisons between test streams and a scoring range generated using data from wadeable/perennial biological criteria reference (**BIOREF**) stations. A station's MSCI score ultimately identifies the ability of a stream to support the beneficial use designation for the protection of warm water AQL.

An MSCI score is a compilation of rank scores that are assigned to individual biological metric values as measures of biological integrity as compared to reference stations. A total of four primary biological metric values are compared to respective BIOREF scoring ranges (e.g., Tables 4 and 5; BIOREF Scoring Table). Primary metrics include: 1) Taxa Richness (**TR**), 2) Ephemeroptera/Plecoptera/Trichoptera Taxa (**EPTT**), 3) Biotic Index (**BI**), and 4) Shannon Diversity Index (**SDI**). Each of these metric values receives a rank score (5, 3, or 1) according to their position within the scoring range. The four rank scores are added to calculate the MSCI for each station. The MSCI scores are

interpreted as follows: 20-16 = fully supporting; 14-10 = partially supporting; and 8-4 = non-supporting of the beneficial use designation for the protection of warm water AQL. MSCI scores are grouped by season and may be compared among stations.

Individual metric values and rank scores are also compared to BIOREF scoring ranges. Variations in the individual metric scores may help identify how a community is affected and identify a potential source of impairment.

2.4.3 Secondary Metric: Dominant Macroinvertebrate Taxa

Secondary metrics are used, in this case, to describe the macroinvertebrate community composition and make comparisons with BIOREF stations. The Dominant Macroinvertebrate Taxa (**DMT**) metric identifies similarities in the macroinvertebrate community composition among test stations and with combined community composition data from BIOREF streams. The ten most abundant taxa in the BIOREF streams (combined) are compared with their abundance in the test streams. Dominance or absence of certain taxa may help identify the type and source of impairment. A detailed taxa list is available in the attached Macroinvertebrate Database Bench Sheets Report (Appendix A).

2.4.4 Physicochemical Water Sampling and Analyses

Physicochemical water samples were handled according to the appropriate MDNR, ESP Standard Operating Procedures (**SOP**) and Project Procedures (**PP**) for sampling and analyzing physicochemical water samples. Results of analyses for physicochemical water variables are examined by season and station.

Water was sampled using field measurements and grab samples. Water was sampled according to the SOP MDNR-ESP-001 *Required/Recommended Containers, Volumes, Preservatives, Holding Times, and Special Sampling Considerations* (MDNR 2011). All grab samples were kept on ice and transported to ESP.

Physicochemical water variables were measured in the field, or by CAS and WQMS at ESP. Temperature (°C), pH, conductivity (µS/cm), dissolved oxygen (mg/L), and discharge (cubic feet per second-**cfs**) were measured *in situ*. The ESP, CAS in Jefferson City, Missouri, conducted analyses for ammonia as nitrogen (**NH_3-N;** mg/L), nitrate+nitrite as nitrogen (**NO_3+NO_2-N;** mg/L), total nitrogen (**TN;** mg/L), chloride (**Cl;** mg/L), total phosphorus (**TP;** mg/L), and non-filterable residue (**NFR;** mg/L). Turbidity (**NTU**) was measured and recorded in the WQMS Biology/Toxicology Laboratory.

Physicochemical water parameters were compared between stations and to Missouri's WQS (MDNR 2010c). Interpretation of acceptable limits within the WQS may be dependent on a stream's classification and its beneficial use designation (MDNR 2010c). Sweetwater Creek is a class P or permanently flowing stream with beneficial uses for LWW, AQL, and WBC, category B. Furthermore, acceptable limits for parameters may be dependent on the rate of exposure. These exposure or toxicity limits are based on long-term (chronic toxicity) or short-term exposure (acute toxicity) effects.

2.4.5 Discharge

Stream discharge was measured using a Marsh-McBirney Flowmate™ flow meter at each station. Velocity and depth measurements were recorded at each station according to SOP MDNR-ESP-113 *Flow Measurement in Open Channels* (MDNR 2010a).

2.5 Dissolved Metals

Grab samples were collected for dissolved metals in the fall and spring. The samples were drawn through 0.45 µm filters and preserved with nitric acid in the field. Dissolved metals included in this project included barium, cadmium, calcium, cobalt, copper, iron, lead, magnesium, nickel, and zinc. Analyses were conducted by the CAS. Hardness as $CaCO_3$ was calculated to determine the chronic and acute exposure toxicity levels (MDNR 2010c).

2.6 Quality Control

Quality control was conducted in accordance with appropriate MDNR, ESP SOPs and PPs.

3.0 Results

Results for stream habitat assessments, biological assessments that include macroinvertebrate community and water quality analyses, and dissolved metals analyses are included in this section. Results are grouped by season and include stations #2 and #1. Trends and notable results are highlighted.

3.1 Stream Habitat Assessment

Stream habitat assessment scores were compared as a percentage of the SHAPP control score (Table 3). All stations exceeded the >75 percent similarity threshold with the SHAPP control. Station #2 had a SHAPP score of 131, which equated to 95 percent of the control score of 138. Station #1 had a SHAPP score of 115, which was 83 percent of the control score. The comparison indicates that stream habitat quality should not be a factor influencing the results in this study.

Table 3
Stream Habitat Assessment Project Procedure (SHAPP) Scores
and Comparisons with Control Stream (in gray)

Station	SHAPP Score	Percent of SHAPP control
Sweetwater Creek #2	131	95
Sweetwater Creek #1	115	83
Blair Creek #1	138	control

3.2 Biological Assessment

Biological assessments consist of macroinvertebrate community analyses and general water quality analyses, which are grouped by fall and spring samples.

3.2.1 Macroinvertebrate Community Analyses

MSCI scores indicated that Sweetwater Creek stations #2 and #1 were fully supporting of the beneficial use for AQL in the fall (Table 4). Station #2 scored 18 and station #1 had an MSCI score of 16. The EPTT metric contributed to the slightly less than optimal value at station #2. The EPTT and BI values were less than optimum at station #1. Overall, however, the individual metric values were relatively similar between stations. The TR was the same at both stations, and both were in the optimal range. Station #2 had two more EPTT than station #1. The BI was higher at station #1 than at station #2. The SDI was slightly lower upstream at station #2 than station #1.

Table 4
Individual Metric Scores, Biological Support Category, and Macroinvertebrate Stream Condition Index (MSCI) Scores for Sweetwater Creek Stations, Fall 2011

Stream and Station Number	Sample No.	TR	EPTT	BI	SDI	MSCI	Support
Sweetwater Creek #2	110956	87	**25**	4.7	3.47	18	F
Sweetwater Creek #1	110955	87	**23**	**5.5**	3.55	16	F
BIOREF Score=5	--	>85	>25	<5.2	>3.28	20-16	**F**ull
BIOREF Score=3	--	85-43	25-13	5.2-7.6	3.28-1.64	14-10	**P**artial
BIOREF Score=1	--	<43	<13	>7.6	<1.64	8-4	**N**on

MSCI Scoring Table (bottom) developed from BIOREF samples (n=23); TR=Taxa Richness; EPTT=Ephemeroptera, Plecoptera, Trichoptera Taxa; BI=Biotic Index; SDI=Shannon Diversity Index
Bold=less than optimal BIOREF score.

MSCI scores indicated that Sweetwater Creek stations #2 and #1 were fully supporting of the beneficial use for AQL in the spring of 2012 (Table 5). Station #2 had a score of 18 and station #1 scored 16. The EPTT metric value contributed to the slightly less than optimum score at both stations. There were two more EPTT at station #2 than at #1. A lower than optimum TR score contributed to the slightly lower score at station #1; station #1 had 19 fewer taxa than station #2. The BI and SDI were relatively similar between stations #2 and #1.

Table 5
Individual Metric Scores, Biological Support Category, and Macroinvertebrate Stream Condition Index (MSCI) Scores for Sweetwater Creek Stations, Spring 2012

Stream and Station Number	Sample No.	TR	EPTT	BI	SDI	MSCI	Support
Sweetwater Creek #2	120006	105	**31**	4.4	3.80	18	F
Sweetwater Creek #1	120005	**86**	**29**	4.4	3.51	16	F
BIOREF Score=5	--	>93	>31	<5.4	>3.36	20-16	**F**ull
BIOREF Score=3	--	93-47	31-15	5.4-7.7	3.36-1.68	14-10	**P**artial
BIOREF Score=1	--	<47	<15	>7.7	<1.68	8-4	**N**on

MSCI Scoring Table (bottom) developed from BIOREF samples (n=21); TR=Taxa Richness; EPTT=Ephemeroptera, Plecoptera, Trichoptera Taxa; BI=Biotic Index; SDI=Shannon Diversity Index
Bold= less than optimal BIOREF score.

The top ten DMT among combined BIOREF samples were compared to Sweetwater Creek stations (Table 6). Nine of the ten taxa that were among the most common in BIOREF streams were either less abundant or absent in Sweetwater Creek stations. These taxa included *Elimia*, *Caenis*, *Tricorythodes*, *Stenelmis*, *Optioservus sandersoni*, *Isonychia bicolor*, Heptageniidae, *Hyalella azteca*, and *Maccaffertium mediopunctatum*. The dominant macroinvertebrate taxa list from the fall of 2011 indicated that the macroinvertebrate communities at Sweetwater Creek were apparently not similar to those found in BIOREF stations. Appendix A shows a detailed list of all taxa collected at Sweetwater Creek stations in the fall.

The top ten DMT collected in the combined BIOREF samples were compared to Sweetwater Creek stations in the spring of 2012 (Table 7). Eight of the ten DMTs from BIOREF samples were less abundant or absent from both Sweetwater Creek stations. These taxa included *Elimia*, *Cricotopus*/*Orthocladius, Stenelmis*, *Stempellinella, Thienemannimyia* grp., *O. sandersoni*, *Acarina*, and *M. mediopunctatum*. Of the two remaining DMTs, *Caenis latipennis* was less abundant in station #2. The DMT list indicated that macroinvertebrate communities in Sweetwater Creek were not similar to the BIOREF stations in the spring of 2012. Appendix A shows a detailed list of all taxa collected in the spring at Sweetwater Creek stations.

Table 6
Dominant Macroinvertebrate Taxa Percentage (and Rank) per Taxon for BIOREF and Sweetwater Creek Stations #2 and #1, Fall 2011

Taxa	BIOREF %	Sweetwater Creek #2	Sweetwater Creek #1
Elimia	9.28 (1)	0.0	0.0
Caenis latipennis	5.44 (2)	0.0	4.09 (8)
Tricorythodes	5.31 (3)	0.0	0.0
Stenelmis	5.16 (4)	0.25 (47)	1.76 (16)
Optioservus sandersoni	4.72 (5)	0.0	2.17 (13)
Isonychia bicolor	4.68 (6)	1.94 (13)	0.56 (34)
Dubiraphia	4.26 (7)	1.60 (15)	7.94 (2)
Heptageniidae	3.69 (8)	0.08 (66)	1.68 (17)
Hyalella azteca	2.95 (9)	0.0	0.0
Maccaffertium mediopunctatum	2.86 (10)	0.0	0.0

Table 7
Dominant Macroinvertebrate Taxa Percentage (and Rank) per Taxon for BIOREF and Sweetwater Stations #2 and #1, Spring 2012

Taxa	BIOREF %	Sweetwater Creek #2	Sweetwater Creek #1
Elimia	8.38 (1)	0.0	0.0
Cricotopus/*Orthocladius*	8.18 (2)	2.20 (8)	5.07 (7)
Tanytarsus	5.48 (3)	10.31 (1)	7.52 (2)
Stenelmis	4.14 (4)	0.08 (77)	2.37 (13)
Stempellinella	3.12 (5)	1.73 (13)	0.59 (27)
Caenis latipennis	3.04 (6)	1.81 (11)	5.75 (5)
Thienemannimyia grp.	2.97 (7)	2.13 (9)	2.11 (15)
Optioservus sandersoni	2.73 (8)	0.0	0.59 (28)
Acarina	2.40 (9)	1.26 (17)	1.35 (19)
Maccaffertium mediopunctatum	2.33 (10)	0.0	0.0

3.2.2 General Water Quality

In general, with two exceptions, water quality variables were present in similar concentrations at the two Sweetwater Creek stations in fall 2011 (Table 8). However, dissolved oxygen was slightly higher upstream at Station #2 (8.82 mg/L) than station #1 (6.75 mg/L). Chloride was slightly lower in station #2 (1.91 mg/L) than station #1 (2.13 mg/L). The values for both variables were within acceptable WQSs (MDNR 2010c).

Table 8
Physicochemical Water Variables in Sweetwater Creek, Stations, Fall 2011

Station Variable/Date	Sweetwater Creek #2 9-29-11	Sweetwater Creek #1 9-28-11
Sample Number	1107092	1107091
pH (Units)	8.3	8.2
Temperature (°C)	14.0	19.0
Conductivity (µS/cm)	118	133
Dissolved O_2	8.82	6.75
Discharge (cfs)	0.31	0.61
NFR	<5.0	<5.0
Turbidity (NTUs)	0.71	0.43
Total Nitrogen	0.056	0.060
Nitrate+Nitrite-N	<0.01	<0.01
Ammonia-N	<0.03	<0.03
Chloride	1.91	2.13
Total Phosphorus	<0.01	<0.01

Units mg/L unless otherwise noted.

Water quality variables were present in similar concentrations in both Sweetwater Creek stations in spring 2012 (Table 9). Interestingly, conductivity was low at both station #2 (56 µS/cm) and station #1 (66 µS/cm), which was potentially due to heavy rain five days prior to sampling (Figure 3). Nitrate+nitrite-N was detected at station #1, but not at station #2. Chloride was slightly higher (0.950 mg/L) at station #1 than station #2 (0.807 mg/L). Both were detected in very low concentrations compared to WQSs (MDNR 2010c).

Table 9
Physicochemical Water Variables in Sweetwater Creek, Stations, Spring 2012

Station Variable/Date	Sweetwater Creek #2 3-21-12	Sweetwater Creek #1 3-21-12
Sample Number	1202910	1202909
pH (Units)	7.5	6.8
Temperature (°C)	15.0	15.0
Conductivity (µS/cm)	56	66
Dissolved O_2	9.35	9.88
Discharge (cfs)	9.05	11.78
NFR	<5.0	<5.0
Turbidity (NTUs)	3.06	3.92
Total Nitrogen	0.057	0.059
Nitrate+Nitrite-N	<0.008	0.01
Ammonia-N	<0.03	<0.03
Chloride	0.807	0.950
Total Phosphorus	0.012	0.010

Units mg/L unless otherwise noted.

3.3 Dissolved Metals

Dissolved metals concentrations in the surface water were not remarkable in fall 2011 Sweetwater Creek samples (Table 10). Dissolved zinc at station #2 (3.56 µg/L) was approximately three times higher than at station #1 (1.06 µg/L). Dissolved cadmium, lead, and nickel were not detected in the surface water of Sweetwater Creek stations in the fall. None of the metals exceeded WQSs (MDNR 2010c).

The concentration of several dissolved metals were higher in the surface water in the spring (Table 11) compared to fall. Dissolved cadmium, lead, and nickel were not detected at station #2. Conversely, dissolved cadmium, lead, nickel, and zinc were detected at station #1. Dissolved cadmium (0.15 µg/L) was below the chronic exposure limit (0.2 µg/L). Dissolved lead was 4.6 times higher at station #1 than the hardness adjusted WQS chronic exposure level of 1.0 µg/L (MDNR 2010c). Although dissolved nickel and zinc were detected downstream, their concentrations did not exceed WQSs.

Table 10
Surface Water (Grab sample) Dissolved Metals (µg/L) and Hardness (HARD; mg/L $CaCO_3$)
for Sweetwater Creek Stations, Fall 2011

Parameter Station	Ba	Cd	Ca	Co	Cu	Fe	Pb	Mg	Mn	Ni	Zn	HARD $CaCO_3$
Sweetwater Creek #2	31.2	<0.1	12.4	<1.0	0.50	11.7	<0.5	7.55	3.89	<0.5	1.06	62.1
Sweetwater Creek #1	33.3	<0.1	13.9	<1.0	0.63	3.08	<0.5	8.47	2.65	<0.5	3.56	69.6

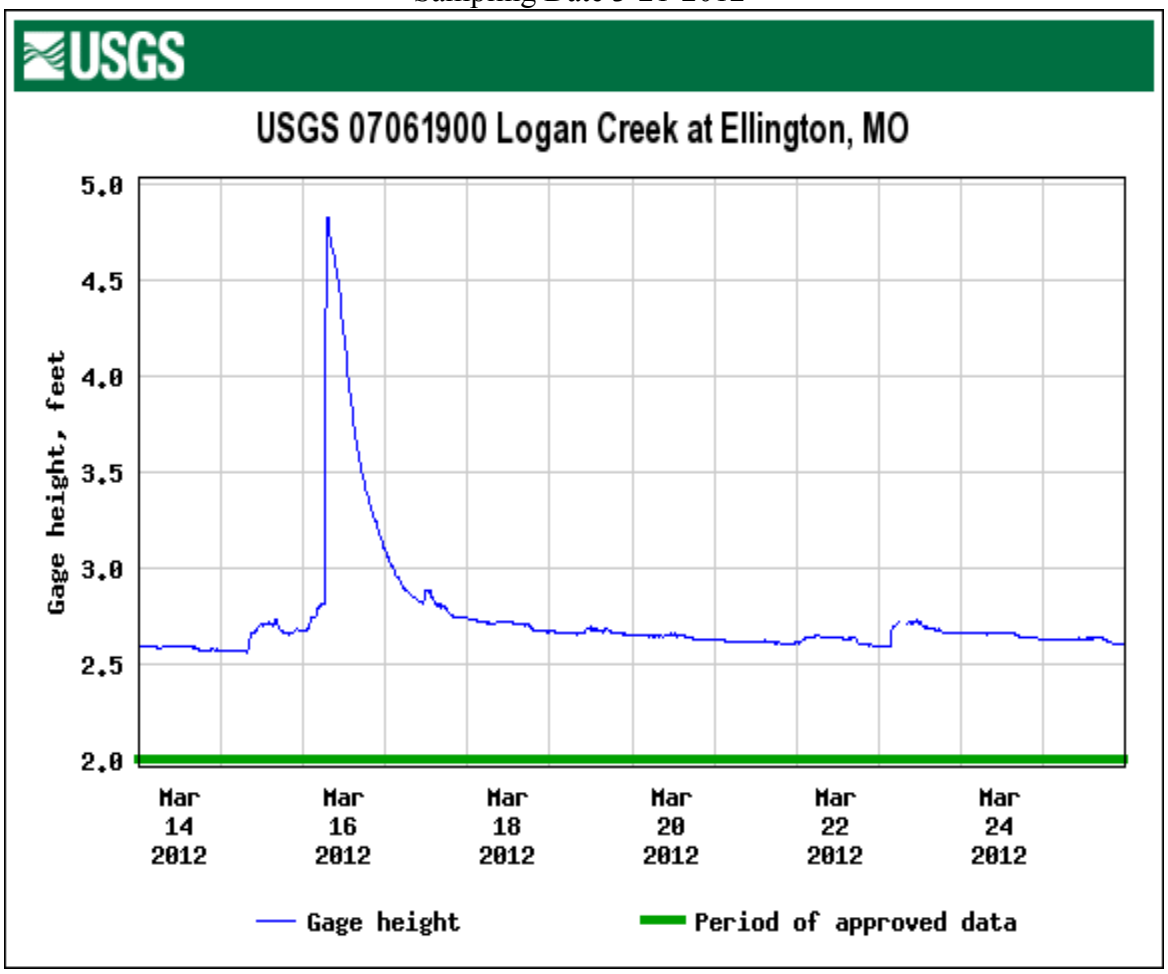
Units µg/L; **Bold**=notable, outside WQS acceptable range, or trend

Table 11
Surface Water (Grab sample) Dissolved Metals (µg/L) and Hardness (HARD; mg/L $CaCO_3$)
for Sweetwater Creek Stations, Spring 2012

Parameter Station	Ba	Cd	Ca	Co	Cu	Fe	Pb	Mg	Mn	Ni	Zn	HARD $CaCO_3$
Sweetwater Creek #2	18.5	<0.1	5.60	<1.0	0.85	122	<0.5	3.24	5.69	<0.5	3.80	27.3
Sweetwater Creek #1	21.0	**0.15**	6.47	<1.0	1.04	64.9	**4.62**	3.83	3.49	**0.75**	**17.3**	31.9

Units µg/L; **Bold**=notable, outside WQS acceptable range, or trend

Figure 3: Illustration of Gage Height Prior to and Including Spring Bioassessment Sampling Date 3-21-2012



4.0 Discussion

The discussion section includes macroinvertebrate community analyses, general physicochemical water variable analyses, and dissolved metals analyses results. Notable results are compared among stations in both seasons.

4.1 Macroinvertebrate Community Analyses

Sweetwater Creek stations were fully supporting of the beneficial use for AQL in both seasons. Station #2 consistently had an MSCI score of 18, whereas station #1 consistently had an MSCI score of 16 in both sample seasons. Both stations consistently had fewer than the optimum number of EPTT than specified for the Ozark/Black/Current EDU biological criteria. Sweetwater Creek #1 had a higher than optimum BI in the fall, which indicates that the macroinvertebrate community was more tolerant to organic enrichment than BIOREF streams. In the spring, station #1 had 19 fewer taxa than the upstream station #2. Although still fully supporting of the AQL, the station #1 macroinvertebrate community, as shown by the much lower TR and EPTT, may be influenced by some stressor such as fluctuating organic pollutant influences or heavy metals concentrations in the surface water. Heavy metals pollution can lead to decreases in TR and EPTT (Carlisle and Clements 1999; Soucek et al. 2000; Clements et al. 2000;

Poulton et al. 2009). Streams of the Viburnum Trend have been shown to be affected by heavy metals, usually associated with precipitation and runoff. The lower MSCI scores observed at the downstream station may be due either to a source of metals between the two stations or the larger watershed downstream may have more of a cumulative effect compared to the upstream station. Despite the difference in the biological metrics, however, both Sweetwater Creek stations were fully supporting of the AQL beneficial use during both seasons.

The dominant macroinvertebrate taxa examination illustrated that the macroinvertebrate community composition in Sweetwater Creek was different from BIOREF stations. Nine of the ten dominant taxa in BIOREF samples were less abundant in Sweetwater Creek stations in the fall, while eight of the ten DMT were less abundant in both stations in the spring.

Interestingly, taxa such as *Elimia* sp. and *Maccaffertium mediopunctatum* were among the dominant taxa among BIOREFs in both seasons, yet they were not found in Sweetwater Creek stations. *Tricorythodes* sp. and *Hyalella azteca* were among the top ten dominant taxa in the BIOREFs in the fall, yet neither was present in Sweetwater Creek stations. Although *Tricorythodes* sp. was not in the top ten taxa among BIOREF samples in the spring, it did rank 21st on the DMT; by comparison, it was absent from both Sweetwater Creek stations. *H. azteca* ranked 30th in abundance among BIOREFs, but it was absent from both Sweetwater Creek stations in the spring. Compared to the BIOREFs, *Optioservus sandersoni* and *Stenelmis* sp. were less abundant at both stations in both seasons. The relatively low abundance of *Elimia* sp.*, M. mediopunctatum, Tricorythodes* sp., *H. azteca*, and *O. sandersoni* suggests that these taxa may be intolerant of some condition that is present in both Sweetwater Creek stations. For example, Clements et al. (2000) found that the number of heptageniid mayflies and *Optioservus* sp. decreased with increasing metals concentrations in surface water. Development of a biotic index for metals would aid in determining whether metals contamination is at least partially responsible for such macroinvertebrate community attributes described above. Collecting fine sediments in this system for metals analyses also could aid in this goal.

4.2 General Water Quality

General water quality variables were not remarkable during either sampling period. In the fall, nutrients were similar upstream to downstream. Although the concentration of chloride was slightly higher downstream compared to upstream, it was present in very low concentrations at both stations. Chloride was well below WQSs at both locations, which suggests organic influences may not have contributed to the high BI in the fall. Likewise, in the spring, nutrients were present in similar concentrations at the upstream and downstream stations. Nitrate+nitrite-N was detected in concentrations slightly above detectable concentrations downstream, but it was not detected upstream. Potentially, this may have been a result of increased organic influences in the humic material or other organic material in the heavy runoff (see Figure 3) after a significant rain event. Regardless of the source, nitrate+nitrite-N was detected in low concentrations, and the BI was within the optimum range. The macroinvertebrate community composition was not obviously affected by the influence of organic pollutants in the spring.

4.3 Dissolved Metals

Although levels of dissolved metals tested were below detectable concentrations or were found in very low concentrations in the fall, dissolved metals concentrations varied between the upstream station (#2) and the downstream station (#1) in the spring. Concentrations of cadmium, lead, and nickel were not detected upstream, but cadmium was near WQSs and lead exceeded WQSs (MDNR 2010c) in the downstream station in the spring. Dissolved nickel and zinc were also elevated downstream compared to upstream, but these metals did not exceed WQSs. The increase from upstream to downstream stations suggests that some influence contributed to the dissolved heavy metals concentrations in Sweetwater Creek during the spring of 2012. Figure 3 shows that a significant rain event occurred several days prior to our sampling in the spring. Runoff, or some other precipitation influenced source, may have contributed dissolved metals to the downstream station at Sweetwater Creek. This observation is consistent with a publication by Brumbaugh et al. 2007 that identified elevated metals concentrations following heavy rain events in Strother Creek. Although elevated metals may not be the sole contributor to the consistently lower individual metric scores downstream, the elevated metals concentration does coincide with the much decreased TR and EPTT scores. As mentioned earlier, TR and EPTT are apparently strongly influenced by increasing metals concentrations (Carlisle and Clements 1999; Soucek et al. 2000; Clements et al. 2000; Poulton et al. 2009). Sweetwater Creek pore water dissolved metals concentrations should be investigated using methods similar to Brumbaugh et al. (2007).

5.0 Conclusion

The objectives have been met. The stream habitat, macroinvertebrate community, physicochemical water quality, and surface water dissolved metals concentrations in the surface water have been evaluated.

Testing of the null hypotheses resulted in the following:

1) Stream habitat quality at both Sweetwater Creek stations was similar longitudinally and to Blair Creek (SHAPP control).

2) MSCI scores showed that the Sweetwater Creek stations were fully supporting of the AQL in both sample seasons. Analyses of individual metrics, however, showed that the downstream station scores were consistently lower than upstream, with fewer sensitive taxa than BIOREF stations. Macroinvertebrate communities at Sweetwater Creek stations were not similar to BIOREF macroinvertebrate communities when dominant taxa were examined.

3) Physicochemical water quality was similar among stations, and the variables were within acceptable WQS ranges.

4) Dissolved metals concentrations were similar between stations in the fall and within acceptable WQSs (MDNR 2010c). However, several metals were detected in the spring station #1 surface water sample. Among those,

cadmium was near the WQS and dissolved lead was 4.6 times higher than the hardness dependent chronic WQS (MDNR 2010c) in the spring. Dissolved nickel and zinc were detected in the spring; however, they were not above WQSs. Presence of these constituents may have resulted from runoff due to heavy rain prior to sampling. There appears to be an intermittent contributor of dissolved metals to Sweetwater Creek concentrations which may cause WQSs exceedances.

6.0 Recommendations

1) Work toward the development of a biotic index for heavy metals.

2) Conduct fine sediment characterization for total metals.

3) Identify dissolved metals concentrations in substrate pore water.

7.0 Literature Cited

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Submitted by: _____

Kenneth B. Lister
Environmental Specialist
Water Quality Monitoring Section
Environmental Services Program

Date: _____

Approved by: _____

Alan Reinkemeyer
Director
Environmental Services Program

AR:klt

c: Trish Rielly, Water Protection Program
Jackson Bostic, Southeast Regional Office Director

Appendix A

Macroinvertebrate Database Bench Sheets Report for Sweetwater Creek
Reynolds County
Stations Grouped by Season

Aquid Invertebrate Database Bench Sheet Report

Sweetwater Cr [110956], Station #2, Sample Date: 9/29/2011 9:00:00 AM

CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
"HYDRACARINA"			
Acarina	5	9	4
COLEOPTERA			
Dubiraphia		3	16
Ectopria nervosa		1	
Helichus lithophilus	1		
Macronychus glabratus			3
Psephenus herricki	29	63	1
Stenelmis		3	
DECAPODA			
Orconectes hylas	5	-99	-99
DIPTERA			
Ablabesmyia		12	
Anopheles			1
Ceratopogoninae	6	3	
Chironomidae	1	1	
Cladotanytarsus	1	1	
Corynoneura	1		
Cricotopus/Orthocladius	2		13
Djalmabatista			2
Eukiefferiella	4		
Forcipomyiinae	2		
Hemerodromia	2		1
Hexatoma	28	-99	
Labrundinia			1

Aquid Invertebrate Database Bench Sheet Report

Sweetwater Cr [110956], Station #2, Sample Date: 9/29/2011 9:00:00 AM

CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Microtendipes	2	68	3
Natarsia		3	2
Parakiefferiella	1	3	
Paramerina			1
Parametriocnemus	5		
Paratanytarsus		2	3
Polypedilum aviceps	87		1
Polypedilum scalaenum grp		1	
Procladius		1	
Rheocricotopus	7		
Rheotanytarsus	4	1	1
Simulium	2		
Stempellinella		14	1
Stenochironomus		2	
Stictochironomus		1	1
Tabanus	5		
Tanytarsus	9	6	3
Thienemanniella		2	2
Thienemannimyia grp.		2	
Tipula	10		
Zavrelimyia		2	
EPHEMEROPTERA			
Acentrella	5		
Acerpenna	5		
Baetis	32		

Aquid Invertebrate Database Bench Sheet Report

Sweetwater Cr [110956], Station #2, Sample Date: 9/29/2011 9:00:00 AM

CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Baetisca lacustris	2	2	
Caenis anceps	3	63	1
Centroptilum			2
Diphetor	10		
Eurylophella			1
Heptageniidae		1	
Isonychia bicolor	23		
Leptophlebiidae		4	17
Maccaffertium pulchellum	180	3	
Maccaffertium vicarium	14		
Stenacron	1	3	
Stenonema femoratum		26	1
GORDIOIDEA			
Gordiidae	-99		
HEMIPTERA			
Microvelia	1		
Rhagovelia	4		
LEPIDOPTERA			
Crambidae	1	1	1
LIMNOPHILA			
Ancylidae			5
Menetus			4
Physella			1
LUMBRICINA			
Lumbricina	2	1	

Aquid Invertebrate Database Bench Sheet Report

Sweetwater Cr [110956], Station #2, Sample Date: 9/29/2011 9:00:00 AM

CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
LUMBRICULIDA			
Lumbriculidae	2		1
MEGALOPTERA			
Corydalus	6		1
Nigronia serricornis	2		1
Sialis		-99	
ODONATA			
Argia		10	1
Calopteryx			2
Gomphidae	14	14	3
Hagenius brevistylus		16	
Neurocordulia		4	1
Stylogomphus albistylus	1	3	
PLECOPTERA			
Acroneuria	-99		
Leuctridae	2		
Neoperla	42	1	
TRICHOPTERA			
Cheumatopsyche	79		
Chimarra	39		6
Helicopsyche	2	2	
Oecetis	2	1	2
Oxyethira			1
Polycentropus	10		
Triaenodes		1	6

Aquid Invertebrate Database Bench Sheet Report

Sweetwater Cr [110956], Station #2, Sample Date: 9/29/2011 9:00:00 AM

CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
TRICLADIDA			
Planariidae	2		
TUBIFICIDA			
Tubificidae		1	1

Aquid Invertebrate Database Bench Sheet Report

Sweetwater Cr [110955], Station #1, Sample Date: 9/28/2011 2:30:00 PM

CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
"HYDRACARINA"			
Acarina	13	11	
COLEOPTERA			
Berosus		2	
Dubiraphia		2	97
Ectopria nervosa		2	
Helichus lithophilus			4
Macronychus glabratus	1		
Optioservus sandersoni	27		
Psephenus herricki	92	46	3
Stenelmis	19	3	
DECAPODA			
Orconectes hylas	-99	-99	
DIPTERA			
Ablabesmyia	3	3	1
Ceratopogoninae	5	5	
Cladotanytarsus	6	3	
Corynoneura	2	4	5
Cricotopus/Orthocladius	34	1	7
Dicrotendipes	1	3	3
Dixella			1
Dolichopodidae		-99	
Forcipomyiinae	1		
Hemerodromia	1		

Aquid Invertebrate Database Bench Sheet Report

Sweetwater Cr [110955], Station #1, Sample Date: 9/28/2011 2:30:00 PM

CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Hexatoma	38	4	1
Lauterborniella	1	3	
Microtendipes	2	8	5
Parachironomus		1	
Parakiefferiella		7	
Paraphaenocladius	1		
Paratanytarsus			8
Pentaneura	1		
Phaenopsectra		1	
Polypedilum	2		
Polypedilum aviceps	11		
Polypedilum convictum	10		
Polypedilum illinoense grp		1	
Pseudochironomus	1	3	
Rheotanytarsus	4	1	
Stempellinella	4	22	1
Stenochironomus		13	
Tabanus		1	
Tanytarsus	62	8	7
Thienemanniella	1		
Thienemannimyia grp.	8	4	4
Tipula	2		
Tribelos			2
EPHEMEROPTERA			
Acentrella	2		

Aquid Invertebrate Database Bench Sheet Report

Sweetwater Cr [110955], Station #1, Sample Date: 9/28/2011 2:30:00 PM

CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Acerpenna	10		
Baetisca lacustris	7	12	2
Caenis anceps	56	3	4
Caenis latipennis	25	19	7
Centroptilum			1
Ephemerellidae	2	1	
Heptageniidae	19		2
Isonychia bicolor	7		
Leptophlebiidae			4
Maccaffertium pulchellum	83		
Procloeon		2	
Stenacron		3	
Stenonema femoratum	1	57	12
HEMIPTERA			
Microvelia	1		1
Rhagovelia	1		
Trepobates			1
LIMNOPHILA			
Menetus			1
Physella	5	4	1
LUMBRICULIDA			
Lumbriculidae	4		
MEGALOPTERA			
Corydalus	1		
ODONATA			

Aquid Invertebrate Database Bench Sheet Report

Sweetwater Cr [110955], Station #1, Sample Date: 9/28/2011 2:30:00 PM

CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Argia	9	15	10
Boyeria			2
Calopteryx			1
Enallagma			56
Gomphidae	12	3	
Gomphus			1
Hagenius brevistylus		2	1
Helocordulia		3	2
Libellulidae			2
Macromia			1
Stylogomphus albistylus		-99	
PLECOPTERA			
Neoperla	7		
Perlesta	1		
Zealeuctra	1		
TRICHOPTERA			
Cheumatopsyche	20		
Helicopsyche	21	1	6
Mystacides		2	
Oecetis	4		5
Polycentropus	1	3	
Triaenodes			21
TRICLADIDA			
Planariidae	4		
TUBIFICIDA			

Aquid Invertebrate Database Bench Sheet Report

Sweetwater Cr [110955], Station #1, Sample Date: 9/28/2011 2:30:00 PM

CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Tubificidae		3	1
VENEROIDA			
Pisidiidae			1

Aquid Invertebrate Database Bench Sheet Report

Sweetwater Cr [120006], Station #2, Sample Date: 3/21/2012 2:10:00 PM

CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
"HYDRACARINA"			
Acarina	8	5	3
AMPHIPODA			
Stygobromus		1	
BRANCHIOBDELLIDA			
Branchiobdellida			1
COLEOPTERA			
Dubiraphia		3	1
Ectopria nervosa		1	
Hydrophilidae		1	
Psephenus herricki	22	4	
Stenelmis			1
DECAPODA			
Orconectes	-99		
DIPTERA			
Ablabesmyia		16	
Cardiocladius			1
Ceratopogoninae		8	7
Chelifera		1	1
Chironomidae	2	6	6
Cladotanytarsus		8	
Clinocera	5	1	
Corynoneura	1	9	2
Cricotopus bicinctus			1

Aquid Invertebrate Database Bench Sheet Report

Sweetwater Cr [120006], Station #2, Sample Date: 3/21/2012 2:10:00 PM

CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Cricotopus/Orthocladius	4	7	17
Dicrotendipes		1	
Djalmabatista		1	
Eukiefferiella	3		
Eukiefferiella brevicalcar grp	2		
Hemerodromia	3	1	3
Heterotrissocladius		2	1
Hexatoma	15		
Krenosmittia		1	
Labrundinia		2	2
Lopescladius	1		
Micropsectra	1	6	1
Microtendipes		3	
Nanocladius		1	
Natarsia		6	
Nilotanypus			1
Orthocladius (Euorthocladius)	1		
Orthocladius (Symposiocladius)		2	
Parakiefferiella		10	
Parametriocnemus	7	3	1
Paraphaenocladius		1	5
Paratanytarsus			7
Polypedilum aviceps	72		5
Polypedilum convictum	3		
Polypedilum illinoense grp		1	

Aquid Invertebrate Database Bench Sheet Report

Sweetwater Cr [120006], Station #2, Sample Date: 3/21/2012 2:10:00 PM

CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Polypedilum laetum		1	
Polypedilum scalaenum grp		2	
Polypedilum tritum			3
Procladius		5	
Psectrocladius		1	2
Rheocricotopus	4	3	16
Rheotanytarsus	3	1	1
Simulium	105		3
Stempellinella		20	2
Stenochironomus		1	1
Stilocladius		1	
Tabanus	-99		
Tanytarsus	46	71	14
Thienemanniella		1	2
Thienemannimyia grp.	4	7	16
Tipula	2		
Tribelos		3	
Tvetenia bavarica grp	3		
Zavrelimyia		13	
EPHEMEROPTERA			
Acentrella	56	1	10
Acerpenna	4		11
Caenis latipennis	5	14	4
Diphetor	16		3
Ephemera	1		

Aquid Invertebrate Database Bench Sheet Report

Sweetwater Cr [120006], Station #2, Sample Date: 3/21/2012 2:10:00 PM

CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Eurylophella	3	4	13
Heptageniidae	17		2
Isonychia	5		
Leptophlebiidae	1		4
Maccaffertium pulchellum	16		1
Maccaffertium vicarium	12		1
Stenacron	4	1	
Stenonema femoratum	1	3	
LEPIDOPTERA			
Petrophila	1		
LIMNOPHILA			
Lymnaeidae			2
LUMBRICULIDA			
Lumbriculidae	3	3	
MEGALOPTERA			
Corydalus	2		
Nigronia serricornis	2		-99
ODONATA			
Calopteryx			3
Hagenius brevistylus		1	2
Stylogomphus albistylus	6	7	2
PLECOPTERA			
Agnetina flavescens	1		
Amphinemura	46	1	23
Chloroperlidae	11	4	

Aquid Invertebrate Database Bench Sheet Report

Sweetwater Cr [120006], Station #2, Sample Date: 3/21/2012 2:10:00 PM

CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Isoperla	29	1	8
Leuctridae	35	19	33
Neoperla	7		
Perlesta	11		
Perlidae	5		10
TRICHOPTERA			
Agapetus	14		
Cheumatopsyche	13		3
Chimarra	13		
Helicopsyche	8	1	1
Hydroptila	2		10
Lype diversa			1
Oxyethira			1
Polycentropus	7		2
Pycnopsyche	-99		7
Triaenodes			2
TRICLADIDA			
Planariidae	1		
TUBIFICIDA			
Enchytraeidae		1	1
Tubificidae		1	1
VENEROIDA			
Pisidiidae		3	

Aquid Invertebrate Database Bench Sheet Report

Sweetwater Cr [120005], Station #1, Sample Date: 3/21/2012 12:40:00 PM

CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
"HYDRACARINA"			
Acarina	4	7	5
COLEOPTERA			
Berosus		1	
Dubiraphia		4	14
Dytiscidae		2	
Ectopria nervosa	3		
Macronychus glabratus			1
Optioservus sandersoni	7		
Paracymus		1	
Psephenus herricki	48	19	
Stenelmis	21	7	
DECAPODA			
Orconectes virilis	-99		
DIPTERA			
Ablabesmyia		23	3
Atherix	1		
Ceratopogoninae	2	3	
Cladotanytarsus		1	
Clinocera	8	6	
Constempellina		1	
Corynoneura		2	5
Cricotopus bicinctus			7
Cricotopus/Orthocladius	12	9	39

Aquid Invertebrate Database Bench Sheet Report

Sweetwater Cr [120005], Station #1, Sample Date: 3/21/2012 12:40:00 PM

CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Dicrotendipes		1	3
Eukiefferiella	1		
Hexatoma	29	7	
Labrundinia			4
Micropsectra	1	4	3
Parametriocnemus	9	4	
Paratanytarsus			12
Polypedilum aviceps	18		
Polypedilum convictum	1		
Polypedilum fallax grp	1	1	
Potthastia	2	2	
Psectrocladius		1	6
Rheocricotopus	4	1	2
Rheotanytarsus	1	3	1
Robackia	7	1	
Simulium	31		1
Stempellinella		4	3
Sympotthastia		1	
Tabanus	2	-99	
Tanytarsus	22	62	5
Thienemanniella	1		2
Thienemannimyia grp.	4	15	6
Tipula	7		1
Tvetenia bavarica grp	3	1	1
Zavrelimyia		1	

Aquid Invertebrate Database Bench Sheet Report

Sweetwater Cr [120005], Station #1, Sample Date: 3/21/2012 12:40:00 PM

CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
EPHEMEROPTERA			
Acentrella	122	5	2
Acerpenna	2		
Baetidae			1
Baetisca lacustris		2	-99
Caenis latipennis	4	42	22
Eurylophella bicolor		1	
Isonychia	5		
Maccaffertium pulchellum	76	4	2
Stenacron	1	3	1
Stenonema femoratum		5	1
LIMNOPHILA			
Physella			2
LUMBRICINA			
Lumbricina		1	
LUMBRICULIDA			
Lumbriculidae		1	
MEGALOPTERA			
Corydalus	-99		
Nigronia serricornis		1	
ODONATA			
Argia	1	3	
Boyeria			-99
Calopteryx			-99
Enallagma			4

Aquid Invertebrate Database Bench Sheet Report

Sweetwater Cr [120005], Station #1, Sample Date: 3/21/2012 12:40:00 PM

CS = Coarse; NF = Nonflow; RM = Rootmat; -99 = Presence

ORDER: TAXA	CS	NF	RM
Gomphidae	4	1	
Hagenius brevistylus		1	1
PLECOPTERA			
Acroneuria	3		
Amphinemura	41	1	17
Chloroperlidae	28	30	
Clioperla clio	-99		1
Helopicus nalatus	1		
Isoperla	62	3	5
Leuctridae	9	10	1
Neoperla	6		
Perlesta	10		23
Zealeuctra		1	
TRICHOPTERA			
Cheumatopsyche	4		2
Chimarra	1		
Helicopsyche	2		1
Hydroptila			2
Oecetis			3
Oxyethira			12
Polycentropus	3	1	
Ptilostomis			-99
Triaenodes	1		3
TRICLADIDA			
Planariidae	5	1	